Chapter 3
Inspection Planning and Quality Control of Fracture Critical Members

3-1. Overview

The inspection of FCMs should receive the highest priority in any bridge inspection program. Some FCMs may have details that are highly susceptible to damage due to repeated loading (i.e., fatigue), or others may be in poor condition due to corrosion or damage. Repairs and modifications can influence the likelihood of problems. The inspector should recognize that age and heavy traffic, particularly trucks, can compound problems. Inspection planning should consider the age of the bridge and traffic information if available.

3-2. Inspection Planning and Quality Control

a. Inspection planning involves having the appropriate equipment available to permit a hands-on inspection. Factors such as location, capacity, traffic, roadway width, height, and water depth must be considered in selecting access equipment. The special equipment may also require more elaborate traffic control provisions or staging.

b. The level of inspection should be tailored appropriately for the bridge being inspected. When establishing priorities for bridge inspection, consideration should be given to the age of the bridge, number of cycles since last inspection, fatigue category for connections and attachments, and extent of nondestructive testing (NDT) during the original fabrication and subsequent repairs. The bridges should be categorized and ranked in order of criticality so that the resources available for the inspections are used to provide the highest degree of safety.

(1) If it becomes necessary to establish bridge inspection priorities, a structural engineer with experience in both load rating and evaluating the types of bridges being considered should be involved in the process. Several things influence relative criticality:

(a) The degree of redundancy.

(b) The live load member stress.

(c) The propensity of the material to crack or fracture.

(d) The condition of specific FCMs.

(e) The existence of fatigue-prone design details.

(f) The previous and predicted number and size of loads.

(2) Stress analysis using the finite element method, coupled with fracture mechanics analysis and materials testing may have to be pursued to identify the structural criticality if such condition is not easily determined.

3-3. NDT and Evaluation

a. There are a number of NDT methods available for quantifying the distressed condition of a FCM. No single test will meet all the needs for a given circumstance, and in many cases it will be necessary to use one or more of these tests in conjunction with another. When NDT is required, the testing must be performed by a person fully qualified in its use (e.g., ASNT Certified inspector). NDT can be conducted using the appropriate process and procedure applicable to the specific conditions being evaluated. The NDT processes commonly used for bridge inspection include visual testing (VT), dye penetrant testing (PT), magnetic particle testing (MT), and ultrasonic testing (UT). Radiographic testing (RT) and eddy current testing (ET) are not common for field applications. These test processes and procedures are covered in detail in American Welding Society (AWS 1985).

b. Serious problems discovered in FCMs must be addressed immediately. This should include closing the bridge if the condition warrants. Less serious problems may require repair, retrofit, or partial closure of the bridge. The inspection results may find that the distress condition of a FCM is subcritical. However, problems may develop slowly over a period of time. The subcritical cracks may grow to a critical length (as discussed in Chapter 4), at which time catastrophic structural failure may occur suddenly. Therefore, periodic inspections and evaluations of FCMs are directed at determining the overall condition of the bridge and identifying potential problem areas before they reach a critical level. To ensure bridge safety, it is important that periodic inspections be performed to ensure that cracks are detected before reaching critical size. Periodic inspections should correlate with expected crack growth rates.

3-4. Guidance for Field Inspection

a. In general, field inspections can be divided into two stages, a scheduled visual inspection and a detailed inspection for structural evaluations. Distressed FCMs or an open surface crack length at least twice the joint thickness can usually be detected by visual inspection without using a magnifying glass or removing the surface coating. Intervals for scheduled visual inspections are in accordance with ER 1110-2-111.

b. If distress indications are found in FCMs by initial VT inspection, detailed inspections must be performed. Paint, corrosive oxides, dirt, debris, grease, and other surface materials on the member must be removed before more detailed PT, MT, or UT inspections can be scheduled to determine additional information pertaining to the conditions of the distress members. A fracture and fatigue analysis can also be performed at this stage to help evaluate how fit the bridge is for service.

c. Retrofitting or replacement of the distressed FCMs must be scheduled immediately if the analysis results indicate bridge failure is imminent.